

AMENDMENTS TO THE CLAIMS

Claims 1-33 (Canceled)

Claim 34 (New) A wireless communication system, comprising:

- a control apparatus;
 - at least one relay apparatus connected with the control apparatus via an optical transmission path; and
 - a plurality of wireless communication terminals communicating wirelessly with the relay apparatus;
- wherein:
- the control apparatus comprises:
 - a first optical transmitting section for converting a downstream electric signal into a downstream optical signal and transmitting the downstream optical signal to the relay apparatus via the optical transmission path, and
 - a first optical receiving section for converting an upstream optical signal transmitted from the relay apparatus via the optical transmission path into an upstream electric signal;
 - the relay apparatus comprises:
 - a second optical receiving section for converting the downstream optical signal transmitted from the control apparatus via the optical transmission path into the downstream electric signal;
 - a transmitting/receiving antenna section for transmitting the downstream electric signal converted by the second optical receiving section to the wireless communication terminal as a wireless signal, and receiving a wireless signal transmitted from the wireless communication terminal as the upstream electric signal; and
 - a second optical transmitting section for converting the upstream electric signal received by the transmitting/receiving antenna section into the upstream optical signal and transmitting the upstream optical signal to the control apparatus via the optical transmission path;
- and
- the wireless communication system further comprises wireless signal level restriction means for attenuating the level of a wireless signal transmitted or received by the relay apparatus

such that a receiving level of the wireless signal received by the relay apparatus is kept within a predetermined range.

Claim 35 (New) A wireless communication system according to claim 34, wherein, where the wireless communication terminals use a respective channel, the predetermined range is smaller than a difference between (a) a leakage ratio which is the ratio of the level of a wireless signal using the respective channel with respect to the level of a frequency component leaking to another channel different from the respective channel, and (b) a signal to noise ratio which is the ratio of the level of a leakage signal from a wireless communication terminal using another channel different from the respective channel with respect to the level of the wireless signal using the respective channel.

Claim 36 (New) A wireless communication system according to claim 34, wherein:
the control apparatus comprises a plurality of the first optical transmitting sections;
the wireless signal level restriction means is a signal dividing section, provided in the control apparatus, for dividing the downstream electric signal;
the signal dividing section divides the downstream electric signal and thus attenuates the level of the downstream electric signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range; and
the first optical transmitting sections convert the downstream electric signals divided by the signal dividing section into downstream optical signals.

Claim 37 (New) A wireless communication system according to claim 34, wherein:
the wireless signal level restriction means is a pilot signal generation section, provided in the control apparatus, for generating a pilot signal to be transmitted while being superposed on the downstream electric signal;
the first optical transmitting section converts the downstream electric signal having the pilot signal superposed thereon into a downstream optical signal;
the relay apparatus further comprises:

a pilot signal detection section for detecting the level of the pilot signal superposed on the downstream electric signal converted by the second optical receiving section; and

a level control section for controlling the level of the wireless signal such that the level of the pilot signal detected by the pilot signal detection section is constant; and

the pilot signal generation section increases the level of the generated pilot signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 38 (New) A wireless communication system according to claim 34, wherein:

the wireless signal level restriction means is provided in the control apparatus, and comprises:

a monitoring section for monitoring whether or not the quality of the upstream electric signal converted by the first optical receiving section fulfills a predetermined condition; and

a level control section for, when the monitoring section determines that the quality of the upstream electric signal does not fulfill the predetermined condition, lowering the level of the downstream electric signal which is to be input to the first optical transmitting section so as to reduce an optical modulation index; and

the level control section reduces the optical modulation index and thus attenuates the power of the downstream optical signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 39 (New) A wireless communication system according to claim 34, wherein:

the wireless signal level restriction means is provided in the control apparatus, and comprises:

a monitoring section for monitoring whether or not the quality of the upstream electric signal converted by the first optical receiving section fulfills a predetermined condition; and

a level control section for, when the monitoring section determines that the quality of the upstream electric signal does not fulfill the predetermined condition, lowering the level of a bias current which is set by the first optical transmitting section so as to reduce an optical modulation index; and

the level control section reduces the optical modulation index and thus attenuates the power of the downstream optical signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 40 (New) A wireless communication system according to claim 34, wherein the wireless signal level restriction means includes a level attenuation section for attenuating the wireless signal to such a level that the upstream optical signal converted by the second optical transmitting section is not distorted.

Claim 41 (New) A wireless communication system according to claim 34, wherein:
communicable areas of the relay apparatuses adjacent to each other partially overlap each other;

the relay apparatuses each comprise level adjustment means for controlling a gain by adjusting the level of the wireless signal transmitted to, and received from, the wireless communication terminal; and

the level adjustment means adjusts the level of the wireless signal, such that a difference between (a) a delay time required for a signal transmitted from the control apparatus to be transmitted via each of the adjacent relay apparatuses onto the wireless communication terminal existing in a region where the communicable areas overlap each other, and (b) a delay time required for a signal transmitted from the control apparatus to be transmitted via the relay apparatus adjacent to the each relay apparatus onto the wireless communication terminal existing in the region where the communicable areas overlap each other, is within a predetermined time period.

Claim 42 (New) A wireless communication system according to claim 41, wherein, where two relay apparatuses adjacent to each other is one set, one set of adjacent relay apparatuses

communicate using a frequency which is different from the frequency used by another set of adjacent relay apparatuses.

Claim 43 (New) A wireless communication system according to claim 41, wherein the transmitting/receiving antenna section has a directivity toward a relay apparatus, among the two adjacent relay apparatuses, which is connected with the control apparatus via a longer optical transmission path than the optical transmission path which connects the control apparatus and the relay apparatus including the transmitting/receiving antenna section.

Claim 44 (New) A wireless communication system according to claim 41, further comprising an optical splitting/coupling section for splitting the optical transmission path which connects the control apparatus and each of the relay apparatuses, wherein one end of the split optical transmission path is connected to the relay apparatus and the other end is connected to another optical splitting/coupling section.

Claim 45 (New) A wireless communication system according to claim 41, further comprising an optical splitting/coupling section for splitting the optical transmission path which connects the control apparatus and each of the relay apparatuses, wherein the optical splitting/coupling section splits one optical fiber connected to the control apparatus into at least a predetermined number of optical fibers, and each of the split optical fibers is connected to a relay apparatus.

Claim 46 (New) A wireless communication system according to claim 41, wherein the level adjustment means adjusts the level of the wireless signal such that the delay times are each a maximum delay time tolerated by the wireless communication system.

Claim 47 (New) A wireless communication system according to claim 34, wherein:
communicable areas of the relay apparatuses adjacent to each other partially overlap each other;

the relay apparatuses each comprise optical signal control means for controlling a delay time of the optical signal transmitted to, and received from, the control apparatus; and

the optical signal control means controls the delay time of the optical signal, such that a difference between (a) a delay time required for a signal transmitted from the control apparatus to be transmitted via each of the adjacent relay apparatuses onto the wireless communication terminal existing in a region where the communicable areas overlap each other, and (b) a delay time required for a signal transmitted from the control apparatus to be transmitted via the relay apparatus adjacent to the each relay apparatus onto the wireless communication terminal existing in the region where the communicable areas overlap each other, is within a predetermined time period.

Claim 48 (New) A wireless communication system according to claim 34, wherein wireless signals used by each of the plurality of wireless communication terminals have at least two different frequencies.

Claim 49 (New) A relay apparatus connected with a control apparatus via an optical transmission path and wirelessly communicating with a plurality of wireless communication terminals, the relay apparatus comprising:

an optical receiving section for converting a downstream optical signal transmitted from the control apparatus via the optical transmission path into a downstream electric signal;

a transmitting/receiving antenna section for transmitting the downstream electric signal converted by the optical receiving section to the wireless communication terminals to as a wireless signal, and receiving a wireless signal transmitted from the wireless communication terminals as an upstream electric signal;

an optical transmitting section for converting the upstream electric signal received by the transmitting/receiving antenna section into an upstream optical signal and transmitting the upstream optical signal to the control apparatus via the optical transmission path; and

wireless signal level restriction means for attenuating the level of a wireless signal transmitted or received by the transmitting/receiving antenna section such that a receiving level of the wireless signal received by the transmitting/receiving antenna section is kept within a predetermined range.

Claim 50 (New) A wireless communication system, comprising:

a control apparatus;
at least one relay apparatus connected with the control apparatus via an optical transmission path; and
a plurality of wireless communication terminals communicating wirelessly with the relay apparatus;
wherein:
the control apparatus comprises:
a first optical transmitter operable to convert a downstream electric signal into a downstream optical signal and transmit the downstream optical signal to the relay apparatus via the optical transmission path, and
a first optical receiver operable to convert an upstream optical signal transmitted from the relay apparatus via the optical transmission path into an upstream electric signal;
the relay apparatus comprises:
a second optical receiver to operable to convert the downstream optical signal transmitted from the control apparatus via the optical transmission path into the downstream electric signal;
a transmitting/receiving antenna section operable to transmit the downstream electric signal converted by the second optical receiver to the wireless communication terminal as a wireless signal, and receive a wireless signal transmitted from the wireless communication terminal as the upstream electric signal; and
a second optical transmitter operable to convert the upstream electric signal received by the transmitting/receiving antenna section into the upstream optical signal and transmit the upstream optical signal to the control apparatus via the optical transmission path;
and
the wireless communication system further comprises a wireless signal level restrictor operable to attenuate the level of a wireless signal transmitted or received by the relay apparatus such that a receiving level of the wireless signal received by the relay apparatus is kept within a predetermined range.

Claim 51 (New) A wireless communication system according to claim 50, wherein, where the wireless communication terminals use a respective channel, the predetermined range is

smaller than a difference between (a) a leakage ratio which is the ratio of the level of a wireless signal using the respective channel with respect to the level of a frequency component leaking to another channel different from the respective channel, and (b) a signal to noise ratio which is the ratio of the level of a leakage signal from a wireless communication terminal using another channel different from the respective channel with respect to the level of the wireless signal using the respective channel.

Claim 52 (New) A wireless communication system according to claim 50, wherein:

the control apparatus comprises a plurality of the first optical transmitters;

the wireless signal level restrictor is a signal divider, provided in the control apparatus, operable to divide the downstream electric signal;

the signal divider divides the downstream electric signal and thus attenuates the level of the downstream electric signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range; and

the first optical transmitters convert the downstream electric signals divided by the signal divider into downstream optical signals.

Claim 53 (New) A wireless communication system according to claim 50, wherein:

the wireless signal level restrictor is a pilot signal generator, provided in the control apparatus, operable to generate a pilot signal to be transmitted while being superposed on the downstream electric signal;

the first optical transmitter converts the downstream electric signal having the pilot signal superposed thereon into a downstream optical signal;

the relay apparatus further comprises:

a pilot signal detector operable to detect the level of the pilot signal superposed on the downstream electric signal converted by the second optical receiver; and

a level controller operable to control the level of the wireless signal such that the level of the pilot signal detected by the pilot signal detector is constant; and

the pilot signal generator increases the level of the generated pilot signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal

transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 54 (New) A wireless communication system according to claim 50, wherein:

the wireless signal level restrictor is provided in the control apparatus, and comprises:

a monitor operable to monitor whether or not the quality of the upstream electric signal converted by the first optical receiver fulfills a predetermined condition; and

a level controller operable to, when the monitor determines that the quality of the upstream electric signal does not fulfill the predetermined condition, lower the level of the downstream electric signal which is to be input to the first optical transmitter so as to reduce an optical modulation index; and

the level controller reduces the optical modulation index and thus attenuates the power of the downstream optical signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 55 (New) A wireless communication system according to claim 50, wherein:

the wireless signal level restrictor is provided in the control apparatus, and comprises:

a monitor operable to monitor whether or not the quality of the upstream electric signal converted by the first optical receiver fulfills a predetermined condition; and

a level controller operable to, when the monitor determines that the quality of the upstream electric signal does not fulfill the predetermined condition, lower the level of a bias current which is set by the first optical transmitter so as to reduce an optical modulation index; and

the level controller reduces the optical modulation index and thus attenuates the power of the downstream optical signal so as to narrow a communicable area of the relay apparatus, and thus allows the level of a wireless signal transmitted by a wireless communication terminal existing in the communicable area to be within the predetermined range.

Claim 56 (New) A wireless communication system according to claim 50, wherein the wireless signal level restrictor includes a level attenuator operable to attenuate the wireless signal to such

a level that the upstream optical signal converted by the second optical transmitter is not distorted.

Claim 57 (New) A wireless communication system according to claim 50, wherein:

communicable areas of the relay apparatuses adjacent to each other partially overlap each other;

the relay apparatuses each comprise a level adjuster operable to control a gain by adjusting the level of the wireless signal transmitted to, and received from, the wireless communication terminal; and

the level adjuster adjusts the level of the wireless signal, such that a difference between (a) a delay time required for a signal transmitted from the control apparatus to be transmitted via each of the adjacent relay apparatuses onto the wireless communication terminal existing in a region where the communicable areas overlap each other, and (b) a delay time required for a signal transmitted from the control apparatus to be transmitted via the relay apparatus adjacent to the each relay apparatus onto the wireless communication terminal existing in the region where the communicable areas overlap each other, is within a predetermined time period.

Claim 58 (New) A wireless communication system according to claim 57, wherein, where two relay apparatuses adjacent to each other is one set, one set of adjacent relay apparatuses communicate using a frequency which is different from the frequency used by another set of adjacent relay apparatuses.

Claim 59 (New) A wireless communication system according to claim 57, wherein the transmitting/receiving antenna section has a directivity toward a relay apparatus, among the two adjacent relay apparatuses, which is connected with the control apparatus via a longer optical transmission path than the optical transmission path which connects the control apparatus and the relay apparatus including the transmitting/receiving antenna section.

Claim 60 (New) A wireless communication system according to claim 57, further comprising an optical coupler operable to split the optical transmission path which connects the control

apparatus and each of the relay apparatuses, wherein one end of the split optical fiber is connected to the relay apparatus and the other end is connected to another optical coupler.

Claim 61 (New) A wireless communication system according to claim 57, further comprising an optical coupler operable to split the optical transmission path which connects the control apparatus and each of the relay apparatuses, wherein the optical coupler splits one optical fiber connected to the control apparatus into at least a predetermined number of optical fibers, and each of the split optical fibers is connected to a relay apparatus.

Claim 62 (New) A wireless communication system according to claim 57, wherein the level adjuster adjusts the level of the wireless signal such that the delay times are each a maximum delay time tolerated by the wireless communication system.

Claim 63 (New) A wireless communication system according to claim 50, wherein:

communicable areas of the relay apparatuses adjacent to each other partially overlap each other;

the relay apparatuses each comprise an optical signal controller operable to control a delay time of the optical signal transmitted to, and received from, the control apparatus; and

the optical signal controller controls the delay time of the optical signal, such that a difference between (a) a delay time required for a signal transmitted from the control apparatus to be transmitted via each of the adjacent relay apparatuses onto the wireless communication terminal existing in a region where the communicable areas overlap each other, and (b) a delay time required for a signal transmitted from the control apparatus to be transmitted via the relay apparatus adjacent to the each relay apparatus onto the wireless communication terminal existing in the region where the communicable areas overlap each other, is within a predetermined time period.

Claim 64 (New) A wireless communication system according to claim 50, wherein wireless signals used by each of the plurality of wireless communication terminals have at least two different frequencies.

Claim 65 (New) A relay apparatus connected with a control apparatus via an optical transmission path and wirelessly communicating with a plurality of wireless communication terminals, the relay apparatus comprising:

- an optical receiver operable to convert a downstream optical signal transmitted from the control apparatus via the optical transmission path into a downstream electric signal;

- a transmitting/receiving antenna section operable to transmit the downstream electric signal converted by the optical receiver to the wireless communication terminals as a wireless signal, and receive a wireless signal transmitted from the wireless communication terminals as an upstream electric signal;

- an optical transmitter operable to convert the upstream electric signal received by the transmitting/receiving antenna section into an upstream optical signal and transmit the upstream optical signal to the control apparatus via the optical transmission path; and

- a wireless signal level restrictor operable to attenuate the level of a wireless signal transmitted or received by the transmitting/receiving antenna section such that a receiving level of the wireless signal received by the transmitting/receiving antenna section is kept within a predetermined range.